

# **FIRE PROTECTION SYSTEMS TECHNICAL GUIDE**



***FIRE PROTECTION ENGINEERING  
CAPITAL IMPROVEMENTS  
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## **1.0 GENERAL:**

This technical guide is a supplement to Unified Facilities Criteria (UFC), Interim Guides (ITG), Southwest Division A-E Guide and NFPA codes. This guide describes information, references and recommended practices relating to design and installation practices specific to West Coast conditions and environment. Guidance in this technical guide takes precedence over UFC, ITG and NFPA codes. This guide must be used in conjunction with the Project Program included in PART 6 to determine the full requirements of this solicitation.

## **1.1 REFERENCES:**

Applicable criteria, Interim Technical Guidance and Design and Planning Policy can be found on the Internet at <http://www.efdsouth.navfac.navy.mil/FacAcq/criteria/index.cfm>. Other applicable Criteria is indicated but not limited to the list below.

The design shall be in accordance with UFC 1-200-01 Design: General Building Requirements, UFC 3-600-01 Fire Protection for Facilities Engineering, Design, and Construction, the National Fire Protection Association (NFPA) codes from the [2002] set and Factory Mutual (FM) Loss Prevention Data Sheets, from the [2002] set, applicable to this facility.

The advisory provisions of the codes shall be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. Reference to the "authority having jurisdiction" shall be interpreted to mean Southwest Division Naval Facilities Engineering Command, Fire Protection Engineer.

All equipment shall be listed in the Underwriters Laboratory (UL) Fire Protection Equipment Directory, [2002] edition; UL Building Materials Directory, [2002] edition; UL Fire Resistance Directory, 2002 edition; the Factory Mutual (FM) Approval Guide, [2002] edition.

ASME/ANSI A17.1 Safety Code for Elevators and Escalators (1996 with addenda 1997)

## **1.2 COMPLIANCE VERIFICATION**

Compliance with the requirements for the Fire Protection Systems/and Life Safety Features will be determined by a review of the design and construction submittals, inspection and final acceptance tests by the Southwest Division Fire Protection Engineer (FPE), and by field inspection and acceptance tests. Design documents shall include completed Code/Criteria Search List. Contractor shop submittals (six sets) shall be per applicable NFPA codes and include shop drawings, data sheets for all equipment and devices, qualification statement and calculations.

As-built drawings and maintenance manuals shall be provided in AutoCAD format (latest version).

## **2.0 FIRE PROTECTION SYSTEMS**

### **2.1 SPRINKLER SYSTEMS:**

- a. Sprinkler contractor shall have a current and valid C-16 license. The sprinkler designer shall be at least NICET Level III certified.
- b. The discharge density, design area and outside hose allowance shall be per UFC 3-600-01.
- c. A-E (Contractor) shall perform flow tests to determine if the water supply is adequate to meet sprinkler system and the hose stream demand by use of Appendix A - Preliminary Hydraulic Analysis worksheet. (For hydraulic calculations, subtract the hose stream demand at the sprinkler system point of connection with the water distribution system or from the nearest fire hydrant, whichever is closer to the sprinkler system riser). If the demand exceeds the supply, then the A&E shall provide fire pump(s) and/or water storage tanks.
- d. Minimum lead-in size of main shall be 150 mm (6 in.)
- e. Terminate drain or test piping to exterior of building
- f. Paint exposed piping with a primer and coat of red paint. Paint piping in concealed areas with a primer only in red.
- g. Do not use sprinkler heads with "O" rings
- h. Reduction in discharge area is not permitted for quick response heads.
- i. On-Off Intermittent flow control heads are not permitted.
- j. (Sprinkler heads below a combustible pier or wharf shall be pendant sprinkler heads installed in the upright position. Sprinkler heads shall be corrosion resistant type.)
- k. Provide a flow switch with control valve for each floor in buildings with more than one story.
- l. The installing contractor shall perform interior sprinkler system piping layout. Contract drawings shall show underground water supply piping, sprinkler system riser locations, and indicate the area to be provided with sprinkler protection (entire building). Do not indicate interior piping or sprinkler head locations.
- m. The preferred location is inside the protected building. Sprinkler system risers located outside shall be provided with a protective weather shelter. Provide guard posts for sprinkler system risers located in open industrial or warehouse areas.
- n. Provide galvanized (hot dipped) sprinkler system piping throughout for pre-action and dry-pipe systems.
- o. Provide a low air pressure switch for transmitting a low air signal to the FACP for pre-action systems.

- p. The pre-action deluge valve actuating circuit shall be Class A (style Eα).
- q. SPRINKLERS IN ELECTRONIC AREAS: Wet pipe system is the first choice. A pre-action sprinkler system can be considered on a case by case based on a need by customer and associated maintenance cost. It is recommended but not required for the power to computer/electronic equipment to be discontinued upon activation of sprinkler system serving that particular room or hazard via flow switch. The shutdown function shall not be initiated by the building fire alarm system. A means shall be provided to test the flow switch. Pre-action valves shall be activated by a cross-zoned smoke detection system. Pre-action sprinkler system sprinkler heads installed in the pendant position shall be the dry pendant type or have return bends.
- r. CLUBS: All clubs shall have sprinkler protection regardless of size and construction type.

## **2.2 FIRE ALARM AND DETECTION SYSTEMS**

- a. BASE WIDE FIRE ALARM SYSTEMS: Shall be independent, stand-alone systems, which are not an integral part of a security, an energy monitoring and control systems (EMCS), or other systems.
- b. FIRE DETECTORS:
  - 1) Do not indicate locations of detectors on contract drawings. Where it is necessary to show detectors, include a note to read: "Devices are shown in suggested locations. Final quantity and layout shall be in accordance with all applicable codes, manufacturer's recommendations, and equipment listings."
  - 2) Concealed Detectors: All concealed detectors under floor areas, attic spaces, duct detectors, blind spaces, etc.) shall be remotely annunciated unless annunciated at the fire alarm control panel.
  - 3) HEAT DETECTORS: Prefer rate compensated heat detectors.
  - 4) Smoke Detectors: (Use Class A style or E alpha initiating circuits for high life risk facilities such as hospitals, detention, child development centers and similar facilities).
  - 5) Duct Smoke Detectors: Provide typical details of duct detector location and arrangement in air handling equipment. Provide weatherproof detector housing when located outdoors.
  - 6) Detectors in Family Housing: Provide multiple station type smoke detectors (with a lithium battery back up) inter-connected with the sprinkler system flow/pressure switch. Do not interconnect the smoke detectors with detectors of other units. Sprinkler flow switch shall only be interconnected to sound detectors in all sprinklered units.
- c. FIRE ALARM CONTROL PANELS (FACP): Locate the FACP just inside the main building entrance in a highly visible and accessible location or in an occupied area.

- d. MANUAL STATIONS: Manual pull stations shall be located at all major exits and in path of egress at every 200 feet of travel distance. Provide manual stations with screw terminals for wiring connections. Do not install break (glass) front type stations or pull-lever, break (glass) rod type stations. Specify stations without glass/plastic rods.
- e. WIRING: For Class A (style Ea, & Z) initiating and notification circuits (when provided), the return loop (home run) for the wires to the FACP shall be in a separate conduit.
- f. CONDUCTORS: Wiring for 24 VDC fire alarm circuits shall be no smaller than No. 14 AWG copper conductors, either solid or stranded (maximum of 19 strands) and 12 AWG conductors for 110 VAC circuits.
- g. ELECTRICAL CONDUIT: Electrical conduit shall be rigid metal, IMT, or EMT. In hazardous areas use rigid metal conduit only. All conduits shall be a minimum of 0.75-inch diameter.
- h. DOOR HOLD-OPEN DEVICES: 120 VAC door hold open devices shall be provided when fire or smoke doors are expected to be propped open for convenience or as necessity of building operations. Door hold-open devices shall be zoned to release in accordance with the current edition of NFPA 101, (*Life Safety Code*). BOQs and BEQs 2 to 5 stories in height, without elevators, shall be provided with 120 VAC door hold open devices at all interior stairwell doors.
- i. Provide fire alarm system sequence of operations per Appendix B
- j. ELEVATORS: Consult with AFT Fire Protection Engineer for details about sequence of operation between the elevator controller and the building FACP. See NAVFAC "Elevator Design Guide dated 10 Jan 2001" at <http://www.efdlant.navfac.navy.mil/criteria>

## 2.3 CARBON DIOXIDE AND HALON ALTERNATIVES

- a. Halon alternative systems (Clean Agents) and CO2 systems are not substitutes for sprinkler protection in accordance with DOD criteria.
- b. SEQUENCE OF OPERATION: Where total flooding rooms and/or under floor systems are automatically activated by cross zoned smoke detection systems, the sequence of operation shall be as follows:
  - 1) Upon activation of the first detector (pre-discharge mode):
    - (i) A pre-discharge alarm (distinct from the building alarm signal) shall sound in the protected area.
    - (ii) An alarm signal shall be transmitted to the base fire department.
  - 2) Upon activation of the second detector (discharge mode):
    - (i) Air handling equipment serving the protected areas shall shut down.

- (ii) All door closures and any required dampers to the protected area shall close.
- (iii) A red revolving light in the protected space shall activate to indicate a discharge. This is not required for protection of underfloor spaces only.
- (iv) The general building fire alarm signal shall sound.
- (v) A time delay (set at a minimum of 20 seconds) shall start. At the end of the time delay the following events shall occur:

- a) Product discharge shall occur in the protected area or zone where the alarm was initiated.
- b) Technical equipment power in the effected area of discharge shall shut down. Consider the need to phase the shutdown of power to protect the technical equipment.
- (c) A visual indicator (i.e., flashing light and warning sign) outside the protected area entrances shall activate indicating that entry is prohibited. This is not required for the system serving only underfloor protected areas.

- c. Upon activation of a manual station all functions under 1) and 2) above shall occur, including the time delayed discharge feature.
- d. Manual stations shall be dual action type.
- e. On Air Force projects an abort switch shall be provided and shall be located within the protected area. No abort switch will be included in Navy project
- f. RESERVE SUPPLY OF HALON ALTERNATIVES AND CO<sub>2</sub>: Provide a complete in-place reserve supply of Halon alternative and CO<sub>2</sub> for each system. Navy projects shall have a main/reserve switch capable of manually transferring the system supply from the main to reserve cylinders.
- g. CO<sub>2</sub> SUPPLY: CO<sub>2</sub> system supply cylinders shall be located outside and adjacent to the protected area.
- h. MANUAL STATIONS: All manual stations shall be distinct (i.e., signs, color and action) from manual building fire alarm stations and manual stations for other extinguishing systems.
- i. CO<sub>2</sub> HOSE REELS: No new hose reels shall be installed in buildings. Existing CO<sub>2</sub> hose reels shall be removed during renovation projects.
- J DOORS: All doors in the protected areas shall be equipped with automatic closures and weather stripping. Doors in the normally open position shall be equipped with electromagnetic door holders to release upon activation of the extinguishing system.
- k. EXHUST SYSTEM FOR CO<sub>2</sub>: Include installation of a ducted exhaust system to exhaust discharged CO<sub>2</sub> to exterior. The exhaust system shall be manually operated.

- l. CONTROL PANELS: Control panels for Halon alternative and CO2 systems shall be equipped with separate alarm silence switches for pre-alarm and discharge alarm circuits.
- m. ACTUATING CIRCUIT: The Halon alternative or CO2 system actuating circuit shall be Class A (style Eα) or solenoid coil supervised.
- n. SEALING THE AREA: All penetrations into and out of the protected area shall be sealed (i.e., cables, conduit, and trenches). Provide details for sealing the area on the contract drawings.
- O. RAINS: Floor drains shall be deep trapped with glycerin or mineral oil type to prevent leakage of the gas out of the protected space.

## **2.4 FIRE PUMPS**

- a. PUMP DRIVE: Electric motors are the preferred driver for fire pumps. Refer to UFC-3-600-01 (current edition) to ascertain "reliability" of commercial power. If the commercial power does not meet the reliability criteria, then an electric pump with secondary power from an on-site generator should be considered. Next preferred arrangement is a diesel engine driven pump. For diesel engine pumps insure that electric circuits are provided for both the pump controller and the engine block heater.
- b. FIRE PUMP ROTATION: Fire pump rotation shall be clockwise. This is to standardize pump rotation for all Navy projects.
- c. ISOMETRIC PIPING DETAILS: Contract drawings shall include an isometric piping detail of each fire pump installation.
- d. SALT WATER FIRE PUMPS: Please contact the Area Focus Team Fire Protection Engineer for specific criteria for salt water rated vertical turbine pumps when provided for pier systems. Salt-water fire pumps shall have special metallurgy or coating systems in accordance with the manufacturer's recommendations.
- e. Provide emergency lighting in fire pump rooms.
- f. DRAINS IN PUMP ROOMS: Fire pump rooms shall be provided with adequate floor drains and a drainage system to the exterior of the building. Circulation relief valves shall be piped to the exterior. Test header outlets shall discharge to safe exterior locations in order not cause property damage when at full flow.
- g. DUAL DRIVEN FIRE PUMPS: Are not acceptable and existing dual driven fire pumps shall be replaced when practical
- h. FIRE PUMPS OR HANGARS: The total pumping capacity shall be such that maximum demand can be met with the largest fire pump out of service.



## **2.5 FOAM EXTINGUISHING SYSTEMS**

- a. AIRCRAFT HANGARS: Use floor nozzles for aircraft hangars (See Naval Facilities Engineering Planning & Design Policy Statement 2001-01)
- b. TYPE OF FOAM AND FOAM CONCENTRATION: AFFF type foam approved for use by EPA shall be used. Currently AFFF surfactants produced by telomerization process are approved for use. Foam system design concentrations shall be 3% for hydrocarbon based fuel fires and 6% for polar solvent or water-soluble based fuel fires.

## **2.6 WET CHEMICAL EXTINGUISHING SYSTEMS**

- a. MANUAL AND AUTOMATIC WET CHEMICAL SYSTEMS: Plenum and duct protection may be omitted with the use of an approved grease extraction system in the hood.
- b. SYSTEMS: All systems shall be arranged to sound the building fire alarm system and shut down power (gas and/or electric) to the protected appliances. When the building does not have a fire alarm system, the extinguishing systems shall be arranged to report directly to the base fire department through the base fire alarm reporting system (where existing). Approved wet type grease extractors shall be arranged to automatically activate upon extinguishing system discharge.
- c. FINAL ACCEPTANCE TEST: utilize a substitute gas (such as compressed nitrogen) for final testing of the system.
- d. MANUAL STATIONS: All manual stations shall be distinct (i.e., signs, color) from fire alarm manual stations and other extinguishing system manual stations. Locate manual stations in the path of exit travel from the protected hazard.

## **2.7 STANDPIPES**

- a. Minimum pressure required at the outlet shall be the minimum pressure required at the tip of fog nozzle plus friction drop-in 2<sup>1</sup>/<sub>2</sub>-inch hose.
- b. STANDPIPES DURING CONSTRUCTION: Standpipe installation shall be concurrent with individual floor construction so that they may be used for emergencies during construction.

## APPENDIX A PRELIMINARY HYDRAULIC ANALYSIS WORKSHEET

### 1. WATER QUANTITY:

a. **Density \* Design Area \* 130%** = \_\_\_\_\_ gpm.  
(Increase the area by 30% for dry-pipe systems and dual-action type preaction systems.)

b. **Outside Hose Stream Demand** = \_\_\_\_\_ gpm.

c. **Other** = \_\_\_\_\_ gpm.  
(Includes water supply for in-rack sprinklers, inside hose streams, oscillating nozzles or other special interior systems.)

d. **Domestic Demand** = \_\_\_\_\_ gpm.

**TOTAL WATER DEMAND** (a+b+c+d) = \_\_\_\_\_ gpm.

### 2. WATER PRESSURE:

a. **End-Head-Pressure** = \_\_\_\_\_ psi.  
 $[density * (area/hd) / k-factor]^2$   
Minimum 7 psi. K-factor is 5.6 for a 0.5-inch orifice, 8.1 for a 0.53-inch orifice, and 11 for a 0.64 inch orifice.

b. **Elevation Loss** = height \* .433 = \_\_\_\_\_ psi.

c. **Outside Friction Loss** = \_\_\_\_\_ psi.  
(Include a reduced pressure back flow preventer for foam systems or a double check valve assembly back flow preventer for all other types of systems.)

d. **Inside Friction Loss** = 20 psi.

**TOTAL PRESSURE** (a+b+c+d) = \_\_\_\_\_ psi.

The pressure required for special interior systems (i.e., rack, oscillating nozzles) must be taken into account.

2. **WATER DEMAND:** The quantity and pressure must be within the limits shown by water supply data. Provide a water supply graph showing the supply and the calculated demand of the system. We are not asking the designer to upgrade the facility water supply, but show that the system specified can be installed with the supply available.

## APPENDIX B

## FIRE ALARM SYSTEM SEQUENCE OF OPERATION MATRIX

INITIATION ACTION	Manual Pull Station	Area Smoke Detector	Fire Alarm Sub-Panel (if used)	Duct Smoke Detector	Smoke Det., Elev Lobby or Elev MechRm	Smoke Det., Elev Lobby - Designatd Flr	WaterFlow Switch	WaterFlow Switch, Elev. Machine Rm	Sprinkler Valve Tampr Switch	Fire Pump Running	Fire Pump Loss of Power	Fire Pump Power Phase Reversal
Activate Fire Alarm Horn & Strobe Lights on all Floors	X	X	X		X	X	X	X				
Display Alarm Indication @ FACP & Remote Annunciator	X	X	X		X	X	X	X		X		
Transmit Alarm Signal to the Base Fire Dept.	X	X	X	X	X	X	X	X		X		
Record Information on Printer & CPU	X	X	X	X	X	X	X	X	X	X	X	X
Close All Fire/Smoke Dampers Serving Alarm Zone or Floor	X	X	X		X	X	X	X				
De-Energize All Electromatgnetic Door Holders on all Floors	X	X	X		X	X	X	X				
Release All Locked Stair Re-Entry Doors within the Bldg	X	X	X		X	X	X	X				
Shut Down Associated AHU				X								
Disconnect Power to Elevator Controllers in Associated Machine rm								X				
Recall Elevators to Designated Level					X							
Recall Elevators to Alternate Level						X						
Display Supervision Condition @ FACP				X					X		X	X
Transmit Supervisory Signal to the Base F.D.									X		X	X